

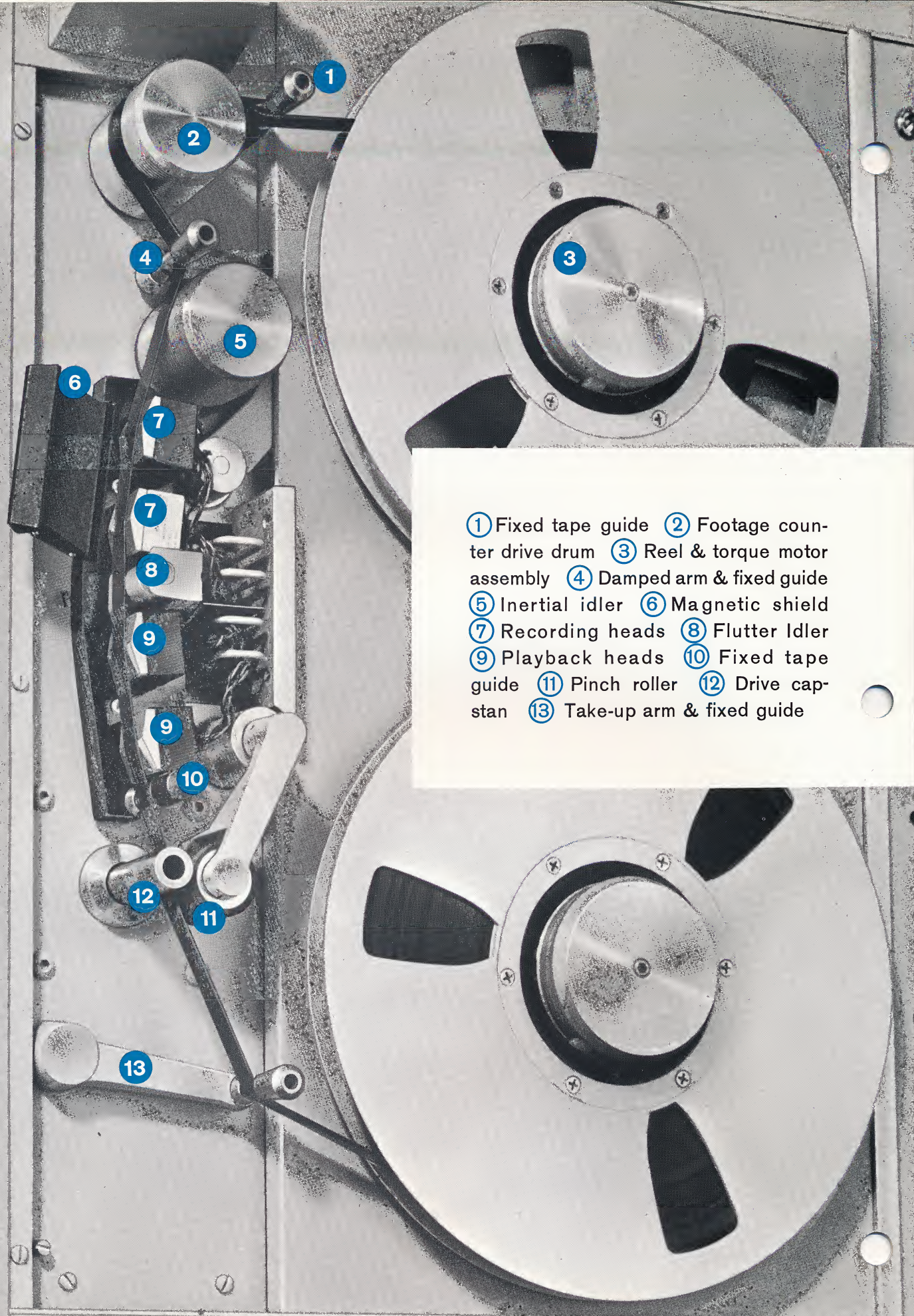
HEWLETT
PACKARD



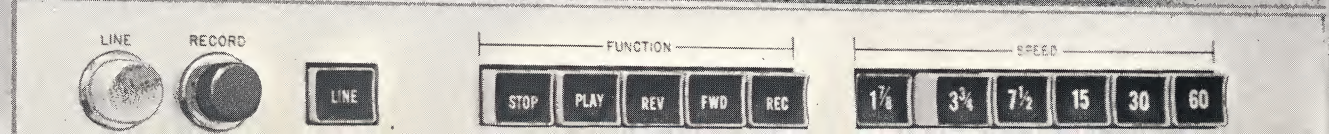
SANBORN
DIVISION

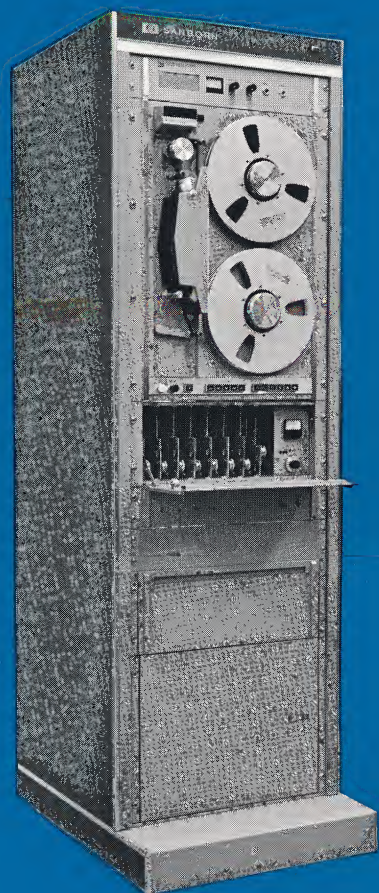
INSTRUMENTATION-CLASS SYSTEMS FOR DIRECT, FM, AND PULSE RECORDING/REPRODUCING

Economical 250 kHz magnetic data recording systems with IRIG compatibility are described inside. An associated system with 1.5 MHz capability described on back cover.



- ① Fixed tape guide ② Footage counter drive drum ③ Reel & torque motor assembly ④ Damped arm & fixed guide ⑤ Inertial idler ⑥ Magnetic shield ⑦ Recording heads ⑧ Flutter Idler ⑨ Playback heads ⑩ Fixed tape guide ⑪ Pinch roller ⑫ Drive capstan ⑬ Take-up arm & fixed guide

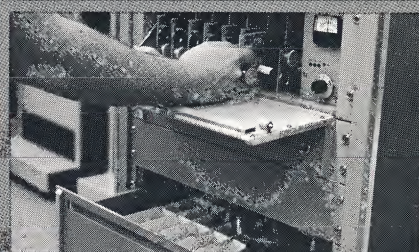
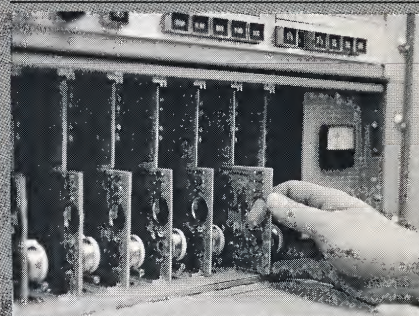
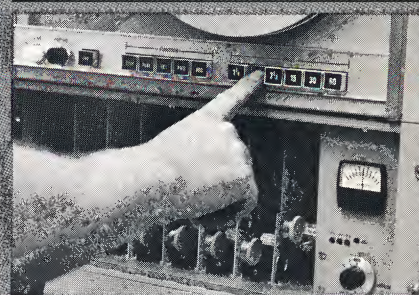
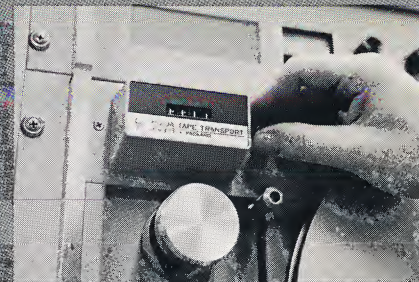




3900

superior performance in direct, fm, or pulse modes • IRIG compatibility • bandwidth to 250 kHz • solid-state plug-in electronics & unique transport design result in lower system cost • easy to use: snap-on reels, straight-through tape path, integral footage counter • portable case or console packaging • many options including voice track, tape loop adapter, remote control •

3900



INSTRUMENTATION PERFORMANCE...at a cost you can afford

Now — precision instrumentation tape recording specifically designed for use in data recording, storage and reduction systems at a cost you can afford . . . Sanborn 3900 Magnetic Tape Recording Systems in low and intermediate bandwidths offer easily interchangeable FM, Direct and Pulse record/reproduce electronics with solid-state amplifier inserts and individual speed equalization plug-ins . . . Sanborn 3900 Systems have a simple, straight-through tape transport for reliable, maintenance-free performance . . . yet a complete recording system with 7 channels, 2 speeds and 7 Record/Reproduce electronics is priced at only \$7991.

Bandwidths range to 250 kHz in Direct mode, and to 20 kHz in FM mode, plus instrumentation quality specifications for signal-to-noise ratios, peak-to-peak flutter, with IRIG compatibility. Six speeds for the system are electrically selected and a 4-second maximum start time and a 2-second maximum stop time provide system use *when* you need it. Both of these systems are compact, versatile and reliable — and cost-per-channel is lower than virtually all comparable systems.

The new tape transport, especially designed by Hewlett-Packard for this series, is combined perfectly with Sanborn electronics to provide a highly flexible, completely useful system. The straight-through design of the tape path affords stable tape motion and simple operation, with maintenance consisting solely of occasional cleaning or dusting of the tape path. This design approach makes possible true IRIG compatibility at a significantly lower cost than comparable servo-controlled systems. The superior performance of this transport is largely due to the rugged, uncomplicated design which does not sacrifice tape motion uniformity for the sake of economy.

Optional equipment such as a tape loop adapter and a voice channel amplifier increase the usefulness of Sanborn 3900 Systems for data analysis and for verbal instructions in teaching applications. Direct, FM and Pulse modes permit single-ended input signals to be connected directly . . . Push-pull signals can be recorded by the Sanborn 3900 through the use of the optional input signal coupler.

APPLICATIONS

Sanborn 3900 Magnetic Tape Recording Systems are so broadly applicable in both simple and complex recording, storage, and data reduction applications — that only a few general applications are men-

tioned here. Major fields include laboratory testing, environmental testing, telemetry, aircraft flight testing, jet and rocket engine testing, vibration studies, etc. Also, aerospace medical researchers, teachers, and educational institutions will find a wide variety of uses for the Sanborn 3900. Applications range from simple data storage and processing to major biophysical applications and physiological data monitoring.

ELECTRONICS

Direct, FM and Pulse recording are possible with Sanborn 3900 Systems utilizing solid-state, plug-in electronics designed for superior system performance. Both the low and intermediate band systems offer interchangeable modular FM, Direct, and Pulse Record/Reproduce electronics consisting of solid-state amplifier inserts and speed equalization plug-ins.

All modules are readily accessible on the front panel to facilitate speed equalizing electronics insert change for each tape speed change. Supply voltages are measured at test points on the front panel. A built-in alignment meter and channel selector switch simplifies the procedure for setting the center frequency and modulation sensitivity of each FM channel. The FM, Direct, or Pulse amplifier inserts, along with the appropriate speed equalization plug-ins, can be used in any combination with the basic assembly.

DIRECT RECORD/REPRODUCE

To proportionately record AC input signals with the 3900, a Direct Record/Reproduce Amplifier insert is used, and, when reproduction of these signals is required, the AC signal is reproduced as a proportional output voltage. Frequency compensation to allow for speed changes for each track in the reproduce mode is provided by individual plug-ins which slide into the Direct Record/Reproduce Amplifier inserts. A built-in bias oscillator provides a fixed amplitude high frequency signal which is mixed with the input voltage to compensate for the non-linearity of the tape.

FM RECORD/REPRODUCE

To convert input voltages into frequencies which are proportionately related to the reference carrier frequency, FM Record/Reproduce Amplifier inserts are used. A full scale input voltage produces a 40% change in carrier frequency. Signals appearing at the record head are square waves of current, sufficient to cause tape saturation on alternate half cycles. Re-

produce head signals are fed into the reproduce preamplifier and then to the FM Record/Reproduce Amplifier insert where they are amplified, clipped, and demodulated. Output voltage of the insert is proportional to the reproduce frequency and, hence, input voltage. Suitable modulation and demodulation frequency characteristics and output filtering is accomplished by an additional speed equalization plug-in (required for each channel).

PULSE RECORD/REPRODUCE

Recording and reconstituting rectangular pulse signals is accomplished with Pulse Record/Reproduce Amplifier inserts. The tape is always driven to saturation. Plug-in speed equalizers are not required for different tape speeds.

CONDENSED ELECTRICAL SPECIFICATIONS

Direct, FM, and Pulse modes permit single-ended signals to be connected directly. Input resistances are 20 K ohms for Direct and FM modes, 10 K ohms for Pulse. Input signal level is adjustable from 0.5 to 10 V rms on Direct, ± 1.2 to ± 3 V peak-to-peak on FM, and a zero based $-7\frac{1}{2}$ to -30 V rectangular pulse on pulse record.

Bandwidth

Standard bandwidth model — 50 to 100 KHz (Direct Mode) — DC to 10 KHz (FM Mode)
Intermediate bandwidth — 50 to 250 KHz (Direct Mode) — DC to 20 KHz (FM Mode)

Signal/Noise Ratio
— 40 db or better

VOICE COMMENTARY

Still another standard feature of the Sanborn 3900 is the inclusion of an edge track for voice commentary. Designed as an additional channel on either 7- or 14-channel systems, this added convenience provides the frequently-needed means of recording pertinent remarks concerning the data being recorded. An optional Voice Channel Amplifier takes only $3\frac{1}{2}$ " panel space above transport and comes complete with microphone for this purpose.

CONTINUOUS MONITORING

For around-the-clock monitoring in applications such as spectrum analysis of transient signals or time delay requirements, a continuous tape-loop recording adapter is available. This closed-loop system, when used in conjunction with a second, relay-

With these Sanborn options you can ...

actuated recorder, is particularly well-suited for recording data variations which may occur instantaneously, but at completely random, unpredictable intervals. The loop adapter is also highly useful for repetitive playback of a series of events, for teaching purposes or repeated examination of data. The optional closed-loop adapter is an integral part of the upright cabinet, and adds only 4 inches to the width.

TAPE TRANSPORT

The tape transport was designed especially for this system by Hewlett-Packard with three objectives in mind — to assure stability of tape motion, low flutter and wow (the key to superior performance) — to reverse the trend of steadily rising prices of high-performance tape systems — and to produce an instrument that required virtually no maintenance while reliably delivering superior performance.

In everything that is essential, the performance of the tape transport used in Sanborn 3900 Systems exceeds that of most instrumentation tape transports and equals all but a very few of the costliest. It can be favorably compared with instruments of three to five times its price. Six electrical speeds are pushbutton selected (standard speeds range from 1 7/8 ips to 60 ips), and no capstan or idler change is necessary. The panel at the left clearly illustrates the rugged simple design, and provides a close look at the straight-through tape path that assures smooth tape motion over the recording and playback heads.

CONDENSED MECHANICAL SPECIFICATIONS

Number of tracks

Models 3907B & 3917B; 7
Models 3914B & 3924B; 14

Maximum interchannel time displacement error

±1 microsecond at 60 ips, between two adjacent tracks on same head

Tape speeds in inches per second

60, 30, 15, 7 1/2, 3 3/4, 1 7/8

Drive speed accuracy

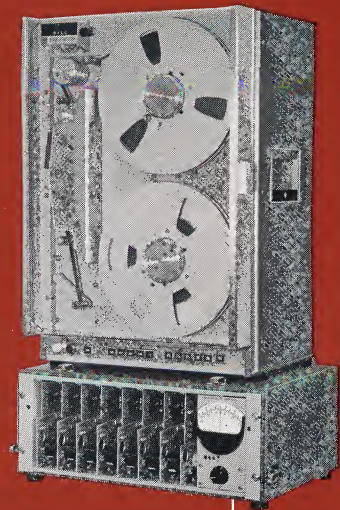
±.25% of nominal capstan speed which is directly proportional to line frequency

System dimensions

72 1/8" high x 22 1/16" wide x 30" deep

System power requirements

105 to 125 volts RMS, 60 Hz, approximately 350 watts.

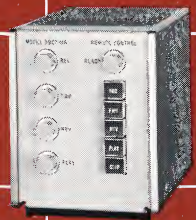


bring your system to the site

add voice commentaries



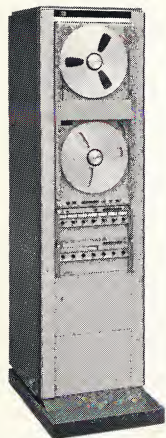
adapt the system to push-pull inputs



control system functions remotely



continuously monitor data



1.5 MHz capabilities with IRIG compatibility

Hewlett-Packard's straightforward approach to instrumentation has resulted in a high-performance 1.5 MHz Magnetic Data Recording System.

Hewlett-Packard 3950 Systems offer freedom from repeated adjustment—and increased parts interchangeability. All major components of the tape path are life-time adjusted at the factory—by being mounted directly on a precision one-piece transport casting. Field maintenance can be performed by the average technician without factory training.

Electronics in Hewlett-Packard 3950 Systems are excellent examples of HP thoughtfulness for the scientific, test or telemetry user. Metering, for example, of both record and reproduce functions is an integral part of the system.

The Hewlett-Packard transport used in the 3950 systems is basically the same rugged, simple design featured in Sanborn 3900 systems. In the 3950 system the tape feeding mechanism and head stack assembly is mounted horizontally between the vertically—oriented tape reels. The same maintenance-free features of the 3900 system are evident in the Hewlett-Packard 3950.

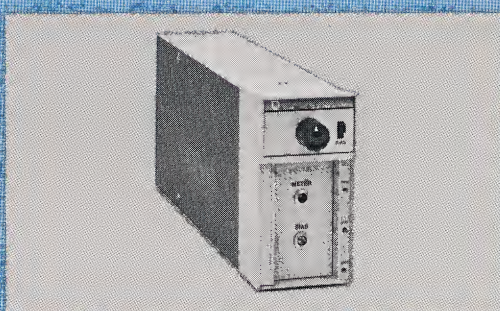
Ultra-precise speed regulation is available in an optional *Tapespeed Servo*. This unit supplies precision 60 Hz capstan motor power, an IRIG standard 17 kHz or 200 kHz at 120 ips carrier control track, and servo speed control during reproduce.

1.5 MHz ELECTRONICS

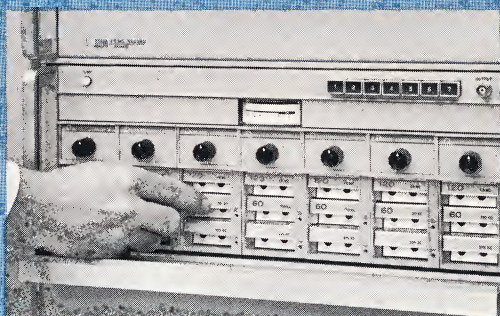
Both record and reproduce electronics are each packaged in self-contained 7-channel main frames including meters that require only 7 inches of vertical rack space. Both main frames contain identical power supplies with interchangeable parts. Interchangeable plug-in amplifiers for Direct or 20 kHz FM record and reproduce electronics are easily removed from front panels. All the amplifiers have exceptionally flat response and fast rise times over a wide frequency band.

CONVENIENT PLUG-IN SPEED EQUALIZER SWITCHING

The arrangement of equalizer switching used in the reproduce amplifier modules eliminates diode switching and reed relays, and provides high reliability with operator convenience. The carefully developed circuits require only 15 transistors per channel compared to several times this in comparable recorders. Each reproduce amplifier holds three color-coded, plug-in equalizers—mechanically switched into the circuit by depressing them from the front panel. As a chosen equalizer is pressed "in", any other equalizer in the circuit is automatically disengaged. This novel approach to equalizer switching increases overall system reliability and decreases costs of the reproduce amplifiers.



Record and reproduce amplifiers are easily removed and replaced by sliding them in or out of the 7-channel main frames. Shown here is the record amplifier module.



Each reproduce amplifier holds three color-coded, plug-in equalizers. When the desired equalizers are pulled into place, the previously-operating unit is automatically disengaged.

Electrical Characteristics

Input Voltage: 0.25 to 30 vrms into 1K ohm

Output Voltage: Up to 1.0 vrms into 75 ohms

Electronic Distortion: When recording at the normal level (1% 3rd harmonic distortion on tape) or less at any frequency, electronically caused distortion is at least 46db below program material.

Mechanical Characteristics

Number of Tracks: 7 or 14

Tape Speeds: 120, 60, 30, 15, 7½, 3¾ ips

Drive Speed Accuracy: $\pm 0.25\%$ of nominal capstan speed which is directly proportional to line frequency. *Higher accuracy available with optional tapespeed servo.*

Maximum Interchannel Time Displacement Error: ± 0.5 microsecond at 120 ips, between two adjacent tracks on the same head stack.

Power Requirements: 105 to 125 volts RMS, 60 Hz (50 Hz optional), approx. 600 watts for 14 channel system.

Bandwidth, Signal-to-Noise Ratios, Rise Times:

| SPEED (ips) | BANDWIDTH* | | MAXIMUM RISE TIME*** |
|-------------|-----------------|------|----------------------|
| 120 | 0.4 kHz-1.5 MHz | 30db | 0.4 uS |
| 30 | 0.4 kHz-375 kHz | 29db | 1.6 uS |
| 7½ | 0.4 kHz-94 kHz | 27db | 6.4 uS |

* $\pm 2\frac{1}{2}$ db 10 kHz to upper band edge; ± 4 db 0.4 kHz to upper band edge.

** Signal frequency at 0.1 X upper band edge; record level at 1% 3rd harmonic distortion on tape using -18db/octave filter 2db down at band edge.

*** Fundamental of square wave at 0.1 X bandwidth.

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